



DIY

Worthwhile projects you can build on your own



Simple dual-band (40-20) parallel dipole antenna

For the purpose of a setting up a quick and portable HF station at local events, such as barbecues, swap meets, and field exercises, I thought I'd create an antenna that is both simple to build and as effective as a dipole. The one featured here supports **40 and 20 meters**, does not suffer from the spurious harmonics of a trap antenna, and is based on my own design and calculations. I affectionately call it the *chopstick antenna*. It does include a *balun* (meant only to connect the *unbalanced* to the *balanced* line), not the *transformer* (impedance-matching) type.

There are many multi-band dipole designs on the web these days, but most of them are the fan type, in which all the active elements meet at a common point and then spread out radially from each other. This particular design presents the elements in a parallel format, such that they still meet at a common point, but spread out parallel to each other. The parallel arrangement requires less vertical displacement, allowing the lowest elements of the antenna to be raised a little higher than that with a fan type.

Parts list

- 55 feet of [16 AWG speaker wire pair](#)
- One [SO-239 flanged bulkhead connector](#)
- Four 3/8" x 36" wooden dowels (round or square)
- Three [3/16" zinc plated eye bolts with nuts](#), 1-1/2"
- 1-1/4" [PVC tube](#), 3-1/2" long
- Three #8 split washers
- Four M3-0.5 mm x 14 mm machine screws
- Four [#8 x 16 AWG ring terminals](#)
- One #4 x 16 AWG ring terminal
- Four [dogbone insulators](#) (you can fabricate these from 1/2" PVC, about 3" long each)
- Two 1-1/4" PVC slip (not threaded) caps
- Three #8 flat washers
- Four M3 split washers
- Four M3-0.5 mm hex nuts
- Small zip ties, 1/4" heat shrink tubing



SO-239 bulkhead

Assembly instructions

Drill a 3/16" hole in the center of one of the slip caps, and install an eye bolt through a flat washer on the outside of the cap. Slip another flat washer onto the eye bolt on the inside, followed by a split washer, then tighten a nut onto the eye bolt of the slip cap assembly and set aside.

Drill a 3/16" hole in the side of the PVC tube 1-1/2" from one end, which I'll refer to as the *top end*. Drill a 1/4" hole just 1/2" below the top hole, placing it 1-1/2" from the *bottom end*. Slip an eyebolt through a flat washer and into the top (3/16") hole. Repeat these on the opposite side.



slip cap assembly

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Cut the 16 AWG speaker wire pair into two pieces, one 34 feet and the other 20 feet long, then separate the pairs. Thread one end each of the 34-foot wire and the 20-foot wire through one of the eye bolts, then into the bottom ($\frac{1}{4}$ ") hole below the side eye bolt. Slip a four-inch-long piece of heat shrink tubing over the two wires, and slide it into the bottom hole, to insulate the wires from excessive wear against the PVC tube bottom hole edge.

Strip the two wires going into the balun body, tie the two together, and solder a #8 ring terminal onto the tied pair. Slip a flat washer, then the ring terminal, and then the split washer onto the eye bolt thread inside the PVC tube. Loosely turn a nut over the thread and repeat this for the other side of the PVC tube.

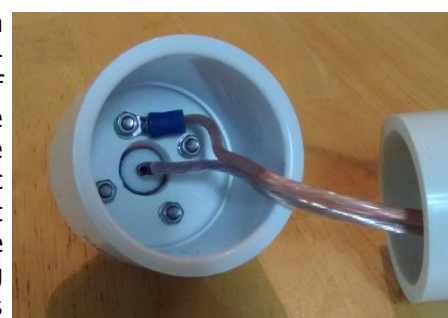


Drill a $\frac{1}{2}$ " hole in the center of the other slip cap. If your slip cap is domed (most are), rather than flat, it'll help with the installation to sand the outside of the cap so that the entire flange of the SO-239 bulkhead sits flush with the cap. Place the solder end of the SO-239 bulkhead into the $\frac{1}{2}$ " hole on the outside of the cap, and using the mounting holes of the bulkhead as a template, drill a $\frac{1}{8}$ " hole for each mounting hole, and deburr (remove the little pieces of shaved PVC from) them. Drill two more



holes through the slip cap next to the SO-239 bulkhead flange, to drain.

Using a 6" piece of the 16 AWG speaker wire pair, strip both sides of each end. Solder a #8 ring terminal to each conductor of one end and a #4 ring terminal to one conductor of the other end. Slip a piece of heat shrink tubing over the remaining conductor, then solder it to the center pin of the SO-239 bulkhead and shrink the tubing. Using the metric screws, washers, and nuts, bolt the SO-239 bulkhead to the slip cap, including the #4 ring terminal to one of the screws on the inside of the cap.



On the inside of the PVC tube, remove the nut and split washer from the side eyebolt. Place one of the #8 ring terminals of the SO-239 bulkhead onto the side eyebolt, followed by the split washer. Tighten the nut over the entire assembly, then repeat this for the opposite side. Zip-tie the element pair on one side of one of the side eye bolts to itself, on the other side of the same eye bolt, to form a large-enough loop through the eye bolt for a drip loop and to provide a strain relief. Center the four-inch heat shrink tubing in the bottom ($\frac{1}{4}$ ") hole, and shrink the tubing. Repeat this for the element pair on the other side eye bolt. This completes the balun assembly.

DIY, continued

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Cut all four dowels in half and sand the edges smooth. Drill a 1/8" hole (or large enough to fit a single insulated speaker wire through) about 3/4" from each end of each dowel, making 16 holes. Thread one of the 34-foot wires through four of the dowels on one end of the dowels, and the accompanying 20-foot wire through the four opposing holes of the same dowels.

Position the first dowel (the one nearest the balun) such that the hole with the 34-foot wire is fairly snug against the eyebolt. Zip-tie the 34-foot wire on the side of the dowel opposite the balun, to prevent the dowel from slipping. Pull the 20-foot wire through the dowel bottom hole as far as possible, such that it's stretched about 17" from the eyebolt to the dowel. Zip-tie the 20-foot wire on the side of the dowel opposite the balun. Position the second dowel about five feet from the first, and the third dowel about five feet from the second. Repeat all of this on the other side.

Insert the 34-foot wire through a dogbone insulator to measure 31 feet 10" from the eyebolt to the dogbone. Wrap up to 6" of the wire around itself, cutting off the excess. Insert the 20-foot wire through another dogbone insulator to measure 15 feet 8" from the first dowel to the dogbone. Wrap up to 10" of the wire around itself, cutting off the excess. Secure each wrap with two zip ties, and repeat this on the other side.



To keep the first dowels vertical, tie the bottom (20-foot) ends with a small length of paracord (photo to the left), and zip-tie the paracord in place.

Provide a strain relief for your SO-239 bulkhead by routing your coaxial cable (RG-8X used here as an illustration) loosely over one of the eyebolts (photo to the right), around behind the balun, then over the other eyebolt. Connect the PL-259 connector of the coax to the SO-239 connector of the balun. Use a DMM (digital multi-meter) to perform a continuity test between all the wires and the balun center conductor, then likewise with the ground side.



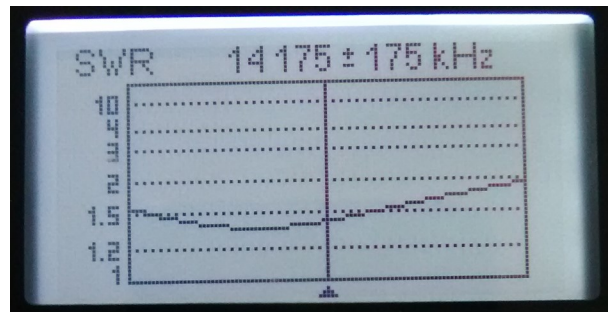
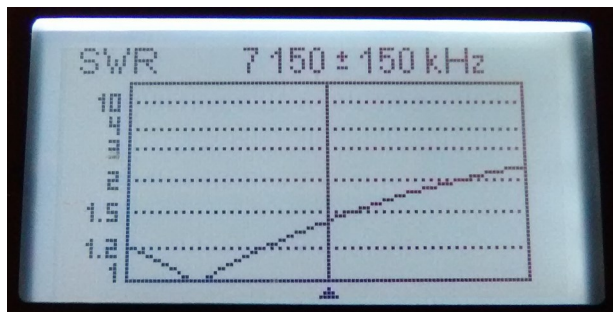


DIY, continued

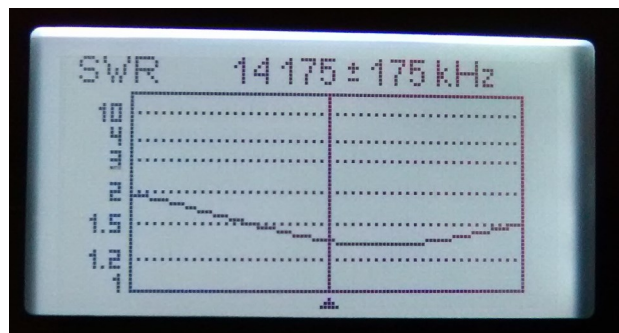
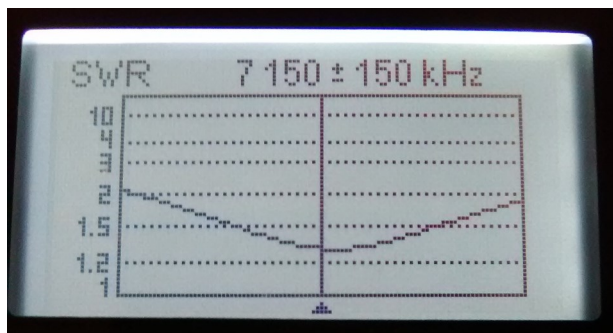
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Testing the result

At last, it was time to take some measurements, and hope that my calculations weren't too far off. I put up a couple of 16-foot masts and hoisted the antenna to about 15 feet in the air. You can see from these initial readings that the antenna will work without a tuner on the 20-meter band, but needs a little help on the 40-meter band. Not bad for the first try.



My inner perfectionist told me I needed to tune this thing to remove the need for a tuner completely, however, so I started adjusting, cutting, and folding back, each time re-hoisting the antenna to take readings. After adjusting and re-adjusting the lengths of the elements, I discovered the sweet spots on the bands by adjusting the 40-meter elements to 32 feet 0", with 8-3/4" folded back, and the 20-meter elements to 15 feet 8", with 10" folded back. The following show the final readings, which look really promising. I say *promising* because I didn't know for sure how the antenna would actually perform until I hoisted it 30 or more feet up in the air.



At that time, I took more measurements, but the real test came when I attempted to make contacts and request signal reports. This was the antenna I erected at the *76ers Barbecue* on Saturday June 1 and at the GOTA station at Field Day. And judging by the contacts made by both the kids and the ham adults at the Barbecue (see the front cover photo), I'd say it was pretty successful. Only thing I would add for a permanent installation is an RF isolator (such as a 1:1 current balun), to reduce the amount of common-mode current and resulting shack RF.

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